

WHAT IS CLAIMED IS:

- 1 1. An optical inspection system, comprising:
 - 2 a light source outputting an annular beam;
 - 3 an objective lens focusing the annular beam at a target;
 - 4 and
 - 5 a detector receiving light scattered from the target,
 - 6 through the objective lens.

- 1 2. The optical inspection system as set forth in claim
2 1, wherein:
 - 3 the light source also outputs a circular beam;
 - 4 the objective lens focuses the circular beam at the
 - 5 target; and
 - 6 the detector receives light reflected from the target
 - 7 through the objective lens.

- 1 3. The optical inspection system as set forth in claim
2 2, wherein the light source produces a selected one of
3 the annular beam and the circular beam in response to a
4 selection of imaging operation type.

- 1 4. The optical inspection system as set forth in claim
2 3, wherein, when the imaging operation type is bright
3 field imaging, the light source is controlled to produce

4 the circular beam, and, when the image operation type is
5 dark field imaging, the light source is controlled to
6 produce the annular beam.

1 5. The optical inspection system as set forth in claim
2 1, wherein:

3 the detector receives the scattered light, as dark field
4 detection, through a portion of the objective lens
5 corresponding to an inner part of the annular beam;
6 and

7 the detector simultaneously receives light reflected
8 from the target, as bright field detection, through a
9 portion of the objective lens corresponding to an
10 outer part of the annular beam.

1 6. The optical inspection system as set forth in claim
2 1, further comprising:

3 a scanner scanning the annular beam along a line in a
4 given scanning direction to provide a scanned single
5 annular beam; and

6 a multiple beam splitter producing multiple annular
7 beams of substantially identical intensity from the
8 scanned single annular beam.

1 7. The optical inspection system as set forth in claim
2 6, wherein:

3 the detector receives the scattered light, as dark field
4 detection, through a portion of the objective lens
5 corresponding to an inner part of each of the annular
6 beams; and
7 the detector simultaneously receives light reflected
8 from the target, as bright field detection, through a
9 portion of the objective lens corresponding to an
10 outer part of each of the annular beams.

1 8. The optical inspection system as set forth in claim
2 6, wherein the detector is a multiple line CCD camera,
3 and wherein each of the multiple annular beams is imaged
4 on a separate one of the lines of the multiple line CCD
5 camera.

1 9. An optical inspection system, comprising:
2 a light source outputting a single beam;
3 a scanner scanning the single beam along a line in a
4 given scanning direction to provide a scanned single
5 beam; and
6 a multiple beam splitter producing multiple beams of
7 substantially identical intensity from the scanned
8 single beam.

1 10. The optical inspection system as set forth in claim
2 9, wherein the multiple beam splitter produces the

3 multiple beams with a diffractive optical element having
4 uniform diffraction efficiency.

1 11. The optical inspection system as set forth in claim
2 10, wherein the diffractive optical element is a Dammann
3 grating.

1 12. The optical inspection system as set forth in claim
2 9, further comprising:
3 an objective lens focusing the multiple beams at a
4 target; and
5 a detector receiving light returned from the target,
6 through the objective lens
7 wherein the detector includes a multiple line CCD
8 camera, and wherein each of the multiple annular
9 beams is received on a separate one of the lines of
10 the multiple line CCD camera.

1 13. An optical inspection system, comprising:
2 a light source outputting a beam; and
3 a scanner scanning the beam in a beam spot across a
4 target, the target being movable in a target movement
5 direction;
6 wherein the beam has a scanning direction not
7 perpendicular to the target movement direction.

1 14. The optical inspection system as set forth in claim
2 13, wherein the beam spot travels a distance in the
3 mechanical scanning direction that is greater than the
4 distance in between scan lines in the mechanical scanning
5 direction.

1 15. An optical inspection system, comprising:
2 a light source outputting a beam;
3 a confocal optical arrangement; and
4 optics for focusing the beam at a target and directing
5 captured light to a detector through the confocal
6 optical arrangement.

1 16. The optical inspection system as set forth in claim
2 15, further comprising a control unit controlling the
3 focus of the optics based on:
4 a light level threshold, and
5 a light level signal indicative of light received by the
6 detector through the confocal optical arrangement.

1 17. A method for optical inspection, comprising:
2 generating an annular light beam;
3 scanning the annular beam along a line in a given
4 scanning direction to provide a scanned single beam;
5 and

6 splitting the scanned single beam to provide multiple
7 beams of substantially identical intensity from the
8 scanned single beam; and
9 detecting signals generated from an interaction between
10 the plurality of multiple beams and an inspected
11 object.

1 18. An optical inspection system, comprising:
2 a light source providing a beam of light through a
3 pupil;
4 a multiple beam splitter receiving the light through the
5 pupil;
6 a scanner receiving the multiple beams and providing
7 scanned multiple beams;
8 a beam splitter receiving the scanned multiple beams and
9 illuminating a target through an objective lens;
10 the objective lens collecting light returned back from
11 the illuminated target and passing the collected
12 light through the beam splitter to an imaging lens;
13 the imaging lens receiving the light passing through the
14 beam splitter and focusing the light to a bright
15 field channel detector.

1 19. The optical inspection system as set forth in claim
2 18, wherein the bright field channel detector includes a
3 multiple line CCD camera, and wherein each of the

4 multiple annular beams is received on a separate one of
5 the lines of the multiple line CCD camera.

1 20. The optical inspection system as set forth in claim
2 18, further comprising:

3 an other beam splitter optically disposed between the
4 imaging lens and the bright field channel detector;
5 and

6 the light from the imaging lens passing through the beam
7 splitter being focused also on a dark field channel
8 detector.

1 21. The optical inspection system as set forth in claim
2 20, wherein at least one of the bright field channel
3 detector and the dark field channel detector includes a
4 multiple line CCD camera, and wherein each of the
5 multiple annular beams is received on a separate one of
6 the lines of the multiple line CCD camera.

1 22. An optical inspection system, comprising:
2 a light source providing a beam of light;
3 a scanner receiving the light through a first beam
4 splitter and providing scanned light;
5 a second beam splitter receiving the scanned light
6 through a scan lens, and illuminating a target
7 through an objective lens;

8 the objective lens collecting light returned back from
9 the illuminated target and passing the collected
10 light to the second beam splitter;
11 the second beam splitter providing part of the collected
12 light, as a returned light signal, back through the
13 scan lens and scanner to the first beam splitter;
14 the first beam splitter deflecting the returned light
15 signal through a focusing lens and a pinhole; and
16 one or more detectors receiving the light through the
17 pinhole.

1 23. The optical inspection system as set forth in claim
2 22, wherein:
3 the light source provides the beam of light through a
4 pupil;
5 a multiple beam splitter receives the light through the
6 pupil;
7 the light received by the scanner includes multiple
8 beams provided by the multiple beam splitter, and the
9 light scanned by the scanner includes multiple
10 scanned beams;
11 the second beam splitter provides part of the collected
12 light through an imaging lens to a bright field
13 channel detector.

1 24. The optical inspection system as set forth in claim
2 23, wherein the bright field channel detector includes a
3 multiple line CCD camera, and wherein each of the
4 multiple annular beams is received on a separate one of
5 the lines of the multiple line CCD camera.

1 25. The optical inspection system as set forth in claim
2 23, further comprising:

3 a third beam splitter optically disposed between the
4 imaging lens and the bright field channel detector;
5 and

6 the light from the imaging lens passing through the
7 third beam splitter being focused also on a dark
8 field channel detector.

1 26. The optical inspection system as set forth in claim
2 25, wherein the multiple scanned beams are annular beams.

1 27. The optical inspection system as set forth in claim
2 25, wherein at least one of the bright field channel
3 detector and the dark field channel detector includes a
4 multiple line CCD camera, and wherein each of the
5 multiple annular beams is received on a separate one of
6 the lines of the multiple line CCD camera.

1 28. The optical inspection system as set forth in claim
2 23, wherein the multiple beam splitter produces the
3 multiple beams with a diffractive optical element having
4 uniform diffraction efficiency.

1 29. The optical inspection system as set forth in claim
2 28, wherein the diffractive optical element is a Dammann
3 grating.

1 30. The optical inspection system as set forth in claim
2 22, wherein:
3 the target is movable in a target movement direction;
4 and
5 the scanner scans with a scanning direction not
6 perpendicular to the target movement direction.

1 31. An optical inspection method, comprising:
2 outputting an annular beam from a light source;
3 focusing the annular beam at a target; and
4 detecting light scattered from the target.

1 32. The optical inspection method as set forth in claim
2 31, further comprising:
3 outputting a circular beam from the light source;
4 focusing the circular beam at the target; and

5 detecting light reflected from the target.

1 33. The optical inspection method as set forth in claim

2 32, further comprising:

3 selecting an imaging operation type;

4 producing a selected one of the annular beam and the

5 circular beam in based on the imaging operation type.

1 34. The optical inspection method as set forth in claim

2 33, wherein, when the imaging operation type is bright

3 field imaging, the light source is controlled to produce

4 the circular beam, and, when the image operation type is

5 dark field imaging, the light source is controlled to

6 produce the annular beam.

1 35. The optical inspection method as set forth in claim

2 31, wherein:

3 the detecting of the scattered light detects the light

4 scattered through a portion of an objective lens

5 corresponding to an inner part of the annular beam;

6 and

7 simultaneously with the detecting of the scattered light

8 there is a detection of light reflected from the

9 target, as bright field detection, through a portion

10 of the objective lens corresponding to an outer part

11 of the annular beam.

1 36. The optical inspection method as set forth in claim
2 31, further comprising:
3 scanning the annular beam along a line in a given
4 scanning direction to provide a scanned single
5 annular beam; and
6 producing multiple annular beams of substantially
7 identical intensity from the scanned single annular
8 beam.

1 37. The optical inspection method as set forth in claim
2 36, wherein:
3 the detecting of the scattered light detects the light
4 scattered through a portion of an objective lens
5 corresponding to an inner part of each of the annular
6 beams; and
7 simultaneously with the detecting of the scattered light
8 there is a detection of light reflected from the
9 target, as bright field detection, through a portion
10 of the objective lens corresponding to an outer part
11 of each of the annular beams.

1 38. The optical inspection method as set forth in claim
2 36, wherein the detecting is performed with a multiple
3 line CCD camera, and includes imaging each of the

4 multiple annular beams on a separate one of the lines of
5 the multiple line CCD camera.

1 39. An optical inspection method, comprising:
2 outputting a single beam;
3 scanning the single beam along a line in a given
4 scanning direction to provide a scanned single beam;
5 and
6 producing multiple beams of substantially identical
7 intensity from the scanned single beam.

1 40. The optical inspection method as set forth in claim
2 39, wherein the producing of the multiple beams is
3 performed with a diffractive optical element having
4 uniform diffraction efficiency.

1 41. The optical inspection method as set forth in claim
2 40, wherein the diffractive optical element is a Dammann
3 grating.

1 42. The optical inspection method as set forth in claim
2 39, further comprising:
3 focusing the multiple beams at a target through an
4 objective lens;
5 receiving light returned from the target, through the
6 objective lens; and

7 detecting the returned light with a multiple line CCD
8 camera by imaging each of the multiple annular beams
9 on a separate one of the lines of the multiple line
10 CCD camera.

1 43. An optical inspection method, comprising:
2 outputting a beam; and
3 scanning the beam in a beam spot across a target, the
4 target being movable in a target movement direction;
5 wherein the beam has a scanning direction not
6 perpendicular to the target movement direction.

1 44. The optical inspection method as set forth in claim
2 43, wherein the beam spot travels a distance in the
3 mechanical scanning direction that is greater than the
4 distance in between scan lines in the mechanical scanning
5 direction.

1 45. An optical inspection method, comprising:
2 outputting a beam; and
3 focusing the beam at a target; and
4 directing captured light to a detector through a
5 confocal optical arrangement.

1 46. The optical inspection method as set forth in claim
2 45, further comprising controlling the focus of the
3 optics based on:

4 a light level threshold, and
5 a light level signal indicative of light received by the
6 detector through the confocal optical arrangement.

1 47. An optical inspection method, comprising:

2 providing a beam of light;
3 providing scanned multiple beams from the beam of light;
4 illuminating a target, with the scanned multiple beams,
5 through an objective lens;
6 collecting light, returned back from the illuminated
7 target, with the objective lens;
8 passing the collected light through to an imaging lens;
9 focusing the light of the imaging lens to a bright field
10 channel detector.

1 48. The optical inspection method as set forth in claim
2 47, wherein the bright field channel detector includes a
3 multiple line CCD camera, and wherein each of the
4 multiple annular beams is received on a separate one of
5 the lines of the multiple line CCD camera.

1 49. The optical inspection method as set forth in claim
2 47, further comprising:
3 providing a beam splitter optically disposed between the
4 imaging lens and the bright field channel detector;
5 and
6 focusing a portion of the light, from the imaging lens,
7 through the beam splitter and also on a dark field
8 channel detector.

1 50. The optical inspection method as set forth in claim
2 49, wherein at least one of the bright field channel
3 detector and the dark field channel detector includes a
4 multiple line CCD camera, and wherein each of the
5 multiple annular beams is received on a separate one of
6 the lines of the multiple line CCD camera.

1 51. An optical inspection method, comprising:
2 providing a beam of light;
3 passing the beam of light through a first beam splitter;
4 scanning the light received through a first beam
5 splitter to provide scanned light;
6 passing the scanned light through a scan lens and a
7 second beam splitter, and illuminating a target
8 through an objective lens;

9 collecting light returned back from the illuminated
10 target;
11 passing the collected light to the second beam splitter;
12 providing part of the collected light, as a returned
13 light signal, back through the scan lens and scanner
14 to the first beam splitter;
15 deflecting the returned light signal, with the first
16 beam splitter, through a focusing lens and a pinhole;
17 and
18 receiving the light through the pinhole using one or
19 more detectors.

1 52. The optical inspection method as set forth in claim
2 51, further comprising:
3 providing the beam of light, from the light source,
4 through a pupil;
5 receiving the light through the pupil at a multiple beam
6 splitter;
7 splitting the beam of light using the multiple beam
8 splitter;
9 providing the scanned light as multiple scanned beams;
10 providing part of the collected light, from the second
11 beam splitter, through an imaging lens to a bright
12 field channel detector.

1 53. The optical inspection method as set forth in claim
2 52, wherein the bright field channel detector includes a
3 multiple line CCD camera, and wherein each of the
4 multiple annular beams is received on a separate one of
5 the lines of the multiple line CCD camera.

1 54. The optical inspection method as set forth in claim
2 52, further comprising:

3 providing a third beam splitter optically disposed
4 between the imaging lens and the bright field channel
5 detector; and

6 focusing the light from the imaging lens through the
7 third beam splitter also onto a dark field channel
8 detector.

1 55. The optical inspection method as set forth in claim
2 54, wherein the multiple scanned beams are provided as
3 annular beams.

1 56. The optical inspection method as set forth in claim
2 54, wherein at least one of the bright field channel
3 detector and the dark field channel detector includes a
4 multiple line CCD camera, and wherein each of the
5 multiple annular beams is received on a separate one of
6 the lines of the multiple line CCD camera.

1 57. The optical inspection method as set forth in claim
2 52, wherein the multiple beam splitter is a diffractive
3 optical element having uniform diffraction efficiency.

1 58. The optical inspection method as set forth in claim
2 57, wherein the diffractive optical element is a Dammann
3 grating.

1 59. The optical inspection method as set forth in claim
2 51, wherein:
3 the target is movable in a target movement direction;
4 and
5 the scanner scans with a scanning direction not
6 perpendicular to the target movement direction.